

## FINAL REPORT

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Observation and Analysis of Jovian and Saturnian Satellite Mutual Events

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### Goals

Acquire high time resolution photometry of satellite-satellite mutual events during the equatorial plane crossing for Saturn in 1995 and Jupiter in 1997. The data would be used to improve the orbits of the Saturnian satellites to support Cassini mission requirements, and also to monitor the secular acceleration of Io's orbit to compare with heat flow measurements.

### Events Observed

1995 July 28	Dione eclipsed Tethys partially (4E3P)
1995 July 29	Saturn eclipsed Titan (disappearance) (6ECD)
1995 July 29	Enceladus occulted Tethys annularly (2O3A)
1995 August 23	Dione occulted Rhea partially (4O5P)
1995 September 1	Tethys occulted Rhea annularly (3O5A)
1995 October 19	Tethys eclipsed Hyperion partially (penumbral) (3E7p)
1995 December 7	Tethys eclipsed Mimas partially (penumbral) (3E1p)
1997 July 3	Io eclipsed Europa partially (1E2P)
1997 July 4	Ganymede eclipsed Europa partially (3E2P)
1997 July 4	Ganymede occulted Europa partially (3O2P)
1997 July 10	Io eclipsed Europa partially (1E2P)
1997 July 16	Europa eclipsed Io partially (2E1P)
1997 July 16	Callisto eclipsed Io totally (4E1T)
1997 July 17	Callisto eclipsed Europa annularly (4E2A)
1997 October 16	Io occulted Callisto partially (1O4P)
1997 October 17	Io eclipsed Ganymede partially (1E3P)
1997 October 20	Ganymede eclipsed Io partially (3E1P)
1997 October 21	Ganymede occulted Europa partially (3O2P)
1997 October 22	Io occulted Europa partially (1O2P)

### Events Scheduled but Lost to Weather or Equipment Problems

1997 June 26	fog
1997 June 27	fog
1997 June 28	fog
1997 October 15	equipment problems

### Facilities Utilized

All the Saturnian satellite events were observed with the University of Hawaii 2.24-m telescope on Mauna Kea, while all the Jovian satellite events were observed with the University of Hawaii #1 0.61-m telescope on Mauna Kea. In all cases, a CCD with high-rate readout capability was utilized, with only a subarray being saved to maximize the time resolution.

### Data Processing

Because of the unconventional method in which these high-time-resolution observations were made, it was necessary to develop customized software to handle the bias subtraction and flat fielding processing steps. Some extended discussions with an experienced CCD observer were necessary to optimize these operations. Substantially trickier was the sky background subtraction for those events occurring closest to the primary, particularly Saturn, whose scattered light component is not radially symmetric due to the rings. It would be naive to assume that the background subtraction has been optimized, and we may decide to revisit this issue on the worst cases at some point in the future. We also had to deal with a case in which the object drifted across a bad column of the CCD, due to the limitations of the 0.61-m telescope's tracking capability.

### Data Analysis

A subset of the data have been fitted to models for the mutual events, in collaboration with Kaare Aksnes of the University of Oslo, and with satisfactory results. Limited manpower and time constraints have precluded analysis of the entire data set for the time being; however, it is our intent to complete the analysis during the next sabbatical opportunity for the P.I., which occurs in 2003.

### Publications

ARLOT, J. E., C. RUATTI, W. THUILLLOT, J. ARSENJEVIC, R. BAPTISTA, J. BARROSO JR., C. BAUER, J. BERTHIER, C. BLANCO, P. BOUCHET, J. BOURGEOIS, H. J. J. BULDER, R. BURCHI, J. A. CANO, R. CASAS, F. CHAUVET, D. CHIS, F. COLAS, J. COLIN, V. D'AMBROSIO, G. DE ANGELIS, G. DE BENEDETTO, H. DENZAU, J. M. DESBATS, P. DESCAMPS, A. DIPALANTONIO, A. DUMITRESCU, L. FARCAS, M. FEDERSPIEL, T. FLATRÈS, M. FROESCHLÉ, O. GHEREGA, J. M. GOMEZ-FORRELLAD, J. GUARRO, O. HAINAUT, A. HORVAT, G. HELMER, D. HUBE, Y. ITO, M. KIDGER, J. LECACHEUX, J. F. LE CAMPION, J. C. LE FLOCH, A. MALLAMA, B. E. MARTIN, J. F. MELLILO, C. MEYER, S. MOLAU, G. MONTIGNAC, B. MORANDO, B. NICOLET, B. NITSCHHELM, G. OPRESCU, A. PIERSIMONI, D. PRZEWOZNY, V. PROTITCH-BENISHEK, M. RAPAPORT, A. RIOU, J. J. SACRÉ, F. SÈVRE, V. SHKODROV, J. SOUCHAY, H. TAKAMI, R. TAYLOR, D. J. THOLEN, V. TURCU, R. VASUNDHARA, J. VIDAL, D. T. VU, G. WHITE, AND R. P. WILDS 1997. A catalogue of the observations of the mutual phenomena of the Galilean satellites made in 1991 during the PHEMU91 campaign. *Astron. Astrophys. Suppl.* **125**, 399-405.

Additional publications forthcoming.



